Protex AI

# Using AI to reduce incidents in the workplace

whitepaper

# The problem with accidents

Accidents are expensive. They damage morale, reduce productivity, and can result in civil and criminal legal proceedings. Most organisations try to prevent major accidents by investigating minor ones, along with near misses. But getting people to report events where there is little or no actual harm can be difficult, and using those reports to identify improvements in occupational health and safety (OHS) management is time-consuming. Can AI provide an effective short-cut? The health and safety team at Marks & Spencer, a well-known British retailer, believe it can. We'll walk you through the arguments for using AI and other technologies as part of your OHS system. At the end, we'll find out if M&S reduced unsafe behaviours.

# Definitions

**Artificial Intelligence (AI):** A system (such as software) that can mimic the way a human behaves. Deep learning techniques enable a system to improve its performance over time, achieving tasks the original programmer hadn't considered.

**Computer Vision (CV):** Analysis of visual inputs, such as CCTV feeds, using AI  to recognise and identify objects, movements and interactions in an image. Within safety, CV can be used to detect physical hazards and hazardous behaviours in the workplace.

**Accident:** An event that results in harm (injury or ill-health). For example, an item falls from a shelf and hits a person causing an injury. Sometimes the term includes events where, although no one was harmed, there was significant damage to property or to the environment.

**Incident:** An event or set of circumstances where harm could have occurred, but didn't. Often divided into:

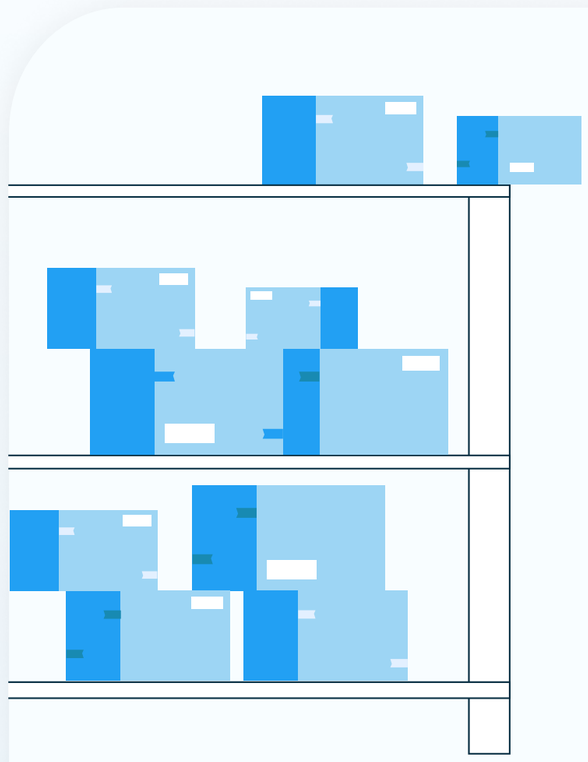
**Near Misses** – A specific event, such as an item falling from a shelf onto the floor, which could have resulted in harm, but didn't.

**Unsafe Conditions** – A situation where harm could occur, such as  an overloaded shelf. An unsafe condition could exist for a long time.

Figure 1 illustrates the difference between an accident, a near miss and an unsafe condition.

Accident

Near miss



Undesired circumstance

## Why do we want to know about near misses and unsafe conditions?

You might be familiar with the Heinrich triangle (figure 2). The numbers at each level vary, but the basic idea is that there will usually be more minor injuries than major injuries, and even more events where there are no injuries.  If you investigate the no-injury events, you have more opportunities to learn how to prevent accidents where people are harmed.


Heinrich's initial model was based on insurance claims from thousands of organisations. Within your own organisation, if you only look at no-injury  events where there is sufficient damage for an insurance claim, you will learn about accidents very slowly. Hence, many organisations ask employees to report near misses and unsafe conditions, providing more opportunities to prevent accidents. But many near misses and unsafe conditions, and even minor injuries, go unreported and are therefore not investigated.

## Why don't people report near misses and unsafe conditions?

Sometimes people don't recognise an unsafe condition. They become accustomed to overloaded shelves, rubbish stored near fire exits, and even the slightly slow braking on a forklift truck, and don't see these as things worth reporting. Some managers unintentionally reinforce unsafe behaviours. A task requires safety goggles, but I do it more quickly without them. Another worker wears safety goggles, and takes more time. The supervisor criticises

the slower (safer) worker, and praises me for working quickly. Who is going to report when goggles aren't worn?

Without the right culture, sometimes even injuries go unreported. A papercut in an office, a prick from a tagging gun in a shop or an abrasion from a tool in a workshop might happen so often that no one thinks to report them. People find quick workarounds for missing tools or damaged equipment, rather than report an unsafe condition.

Even if people want to report unsafe conditions or near misses, reporting systems can be difficult to access or time consuming. Figure 3 shows some of the reasons that people give for not reporting incidents.

Some organisations work hard to increase reporting by workers – and then realise they don't have the resources to deal with all the reports coming in. Without a clear strategy for reviewing reports, taking action and giving feedback, people will stop reporting.

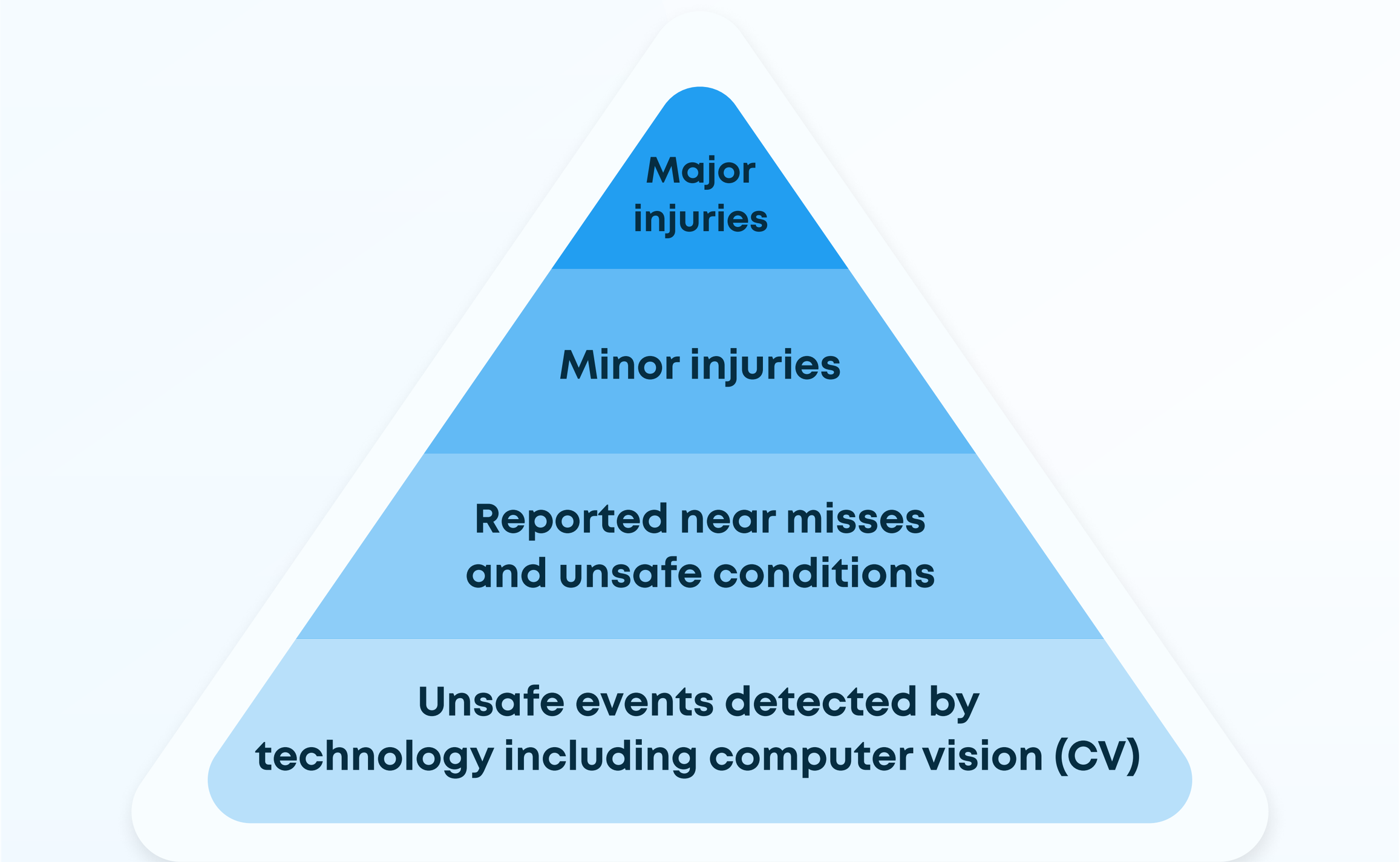
It's a lot of work to review each incident report. You need to be able to decide if an event was a one-off, or part of a pattern. Is it linked to behaviour or equipment? What other incidents need to be considered at the same time?

How can we get smarter at dealing with this?

## Using technology to expand the bottom of the triangle

Figure 2 showed how investigating no-injury events provides more opportunities to learn what needs to be done to prevent accidents. If there was another layer below that in the triangle, it would be even broader – even more opportunities to learn. But without technology, there will be even more admin for an overworked investigation team.

Technology can provide the extra layer, but with less effort. Figure 4 illustrates this idea. Heinrich's no-injury events have been replaced with near miss and unsafe condition reporting, and a fourth, broader layer has been provided by technology, including AI-supported computer vision.




## How does technology do this?

Technology now supports the collection of information about unsafe conditions and near misses automatically, before anyone spots the unsafe condition – and long before anyone fills in an incident report form. Examples of this are shown in Table 1.

Table 1: How technology adds opportunities to prevent accidents

| Type | Example opportunity |
|---|---|
| **Location sensors** | **Temperature:** Detecting excessive heat inside machinery could indicate that it is about to fail, and enable action to be taken before maintenance becomes urgent.<br><br>**Noise:** Increased noise is a hazard and, like temperature, can indicate a problem with machinery<br><br>**Air:** Real-time changes in air quality, including the presence of hazardous gases or particulates, can trigger immediate alarms to warn people of the danger.<br><br>**Motion:** Movement detection can indicate if there are people in a prohibited area, for example, close to moving parts of machinery |
| **Tool sensors** | Temperature, noise and vibration can be sensed directly from a tool. Devices measuring vibration can trigger an alert when exposure reaches a pre-set limit. |
| **Wearable devices** | Wearable devices collect information about movement, heart rate or fatigue. Others are incorporated into clothing to provide an audible warning when a person is too close to a vehicle or dangerous machinery. |
| **GPS** | Devices in vehicles, in clothing or in mobile phones can track location. This can be combined with information collected about hazards to see where people are when they are exposed to noise, air pollutants etc. |
| **Internet of Things (IoT)** | The IoT allows data to be collated from multiple sources, so that patterns of readings can be identified and acted on. |
| **Computer vision** | Allows defined events to be detected from visual images (including CCTV) and counted, with real-time alerts, and collated reports of event frequency. |

While location sensors provide information about a single workplace, wearable technology, such as watches or devices incorporated into PPE, can provide information about an individual's exposure to risk as they move around. However, wearable technology at work faces several barriers.

People must remember to wear it, and keep it switched on. Workers sometimes turn off devices that provide a vibrating or audible alert because of false alarms or over-sensitive triggering. While a proximity device might be a small RFID tag attached to a high-vis jacket, some of the technology for assessing posture requires sensors directly on the skin to measure muscle activation. Despite promises of anonymity, people have concerns about privacy with wearable devices.

Computer vision (CV) provides an alternative to some wearable or location-based devices. It is less personal than wearable technology, and sees people and machinery only as objects. It can detect when two objects are too close to each other (such as when a person is too near a vehicle), when an object is moving too fast (such as a speeding vehicle) or in the wrong direction (in a one-way system), when a required object is missing (such as a high-vis jacket) and even when an object is the wrong shape (such as when someone's posture could cause an injury).

Unlike wearable tech, CV doesn't rely on people to charge it, wear it and leave it switched on. The information collected by CV can be more easily anonymised.

Analytics software can review data from sensors, computer vision and other monitoring systems to identify trends and patterns in safety behaviour. Critical information can be selected and highlighted, and presented in summary form, using graphs and tables to improve understanding of workplace risk.

## What should you be detecting?

The choice of technologies might feel overwhelming. Where should you start? The following steps will help you to get the best return on your investment in technology:

1. **Identify hazards where there isn't sufficient evidence that controls are effective.**
   Your risk assessments should show where existing controls are dependent on people needing to remember to do something, or to avoid something. For example, if a control in a risk assessment states "the worker will not overload the shelf" how is that achieved? If by training, do you have evidence that people apply their learning once they leave the training room? Audits, accident and incident reports, inspection records and safety observations will also help you to identify target hazards.

2. **For the target hazards, identify critical workplace activities.**
   Look at documents, such as safe operating procedures and method statements, which describe how tasks need to be done, who can do it, and what tools and equipment are needed. Within a procedure there might be some steps that you know work well, and others that you are concerned about. For example, you notice that staff tend to wear their safety boots all day, but they often forget their hearing protection in the plant room. Or you know that the shelves in the post room will only contain regular shaped parcels, but the shelves in the workshop can contain awkward and heavy items which don't stack well.

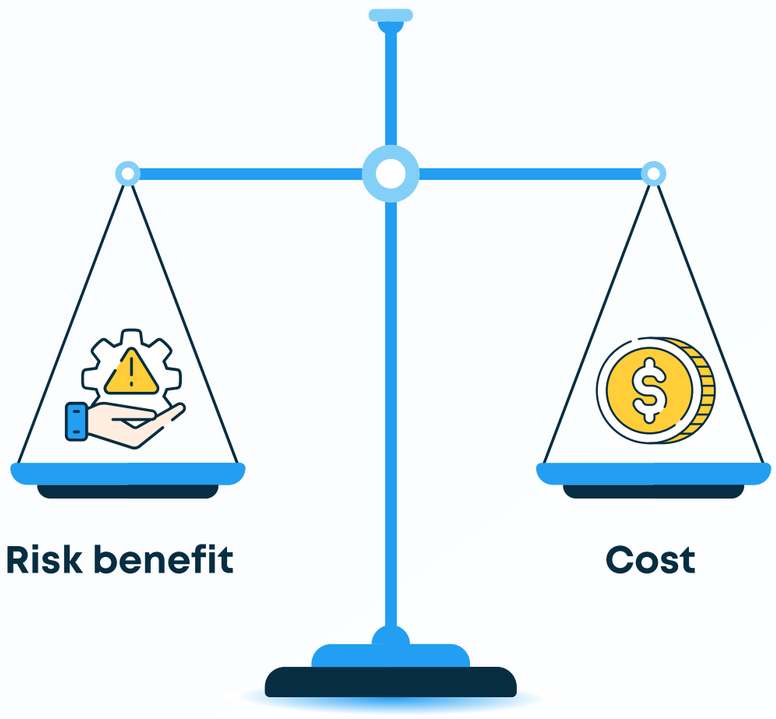
3. **For each critical workplace activity, define goals for that activity.**
   Your list might look like Table 2 (refer to the next page).

4. **Agree some priority goals with workers and other interested parties.**
   Selected goals must be reasonable and achievable. Talk to workers to develop goals that are meaningful to them - they might suggest simpler solutions. For example, providing a trolley that is easier to use might help them to meet a goal without the need for high-tech solutions. Involving people will also help to create a culture where workers believe the technology is there to serve them, not to police them.

Table 2: Example target activities and goals

| Activity | Goals |
|---|---|
| **Driving a forklift truck from loading bay to the warehouse** | Drive at 10 km/h or slower<br>Drive within vehicle zone<br>Maintain greater distance from pedestrians when reversing |
| **Collecting deliveries from the loading bay** | Use a trolley when load is heavy or awkward<br>Walk within pedestrian zone |
| **Making deliveries to the plant room** | Use a trolley when load is heavy or awkward<br>Wear hearing protection for entry into the plant room |
| **Stacking items on warehouse shelving** | Stack items on the correct shelf for the weight and size<br>Don't stack any shelf more than two boxes high<br>Any odd-shaped items should be in boxes |

5. **Determine the best technology to achieve the goal.**
It's better to manage two or three goals well, than to manage a dozen badly. You need to balance the risk benefit of achieving a goal with the cost in time, effort and money of managing it. Checking that vehicles are driving within the speed limit might reduce the risk more than checking vehicles are in the right zone; using CV to check that people aren't over-reaching might be easier to achieve than to check that shelves are stacked correctly.




6. **Run a pilot.**
Try the new technology in one part of the organisation before extending to other areas. Keep the worker representatives involved, as they will help you to see whether anything needs to be changed before you expand the programme to other parts of the workforce, and to meet other goals.

7. **Keep it going.**
Giving feedback at team level reinforces a culture where people support each other to do things safely. Tell a team that they are wearing PPE correctly 70% of the time, and you would like them to get a higher score next month. The supervisor now has a reason to praise the person who wears safety goggles, and everyone in the team will want to remind the person who doesn't. Once a team achieves their goal for a whole month, continue to encourage and reinforce the behaviours. Make sure that doing the right thing continues to be the best option.

## What do I do once it’s all working

Imagine everyone is able and willing to do every task safely. They create no unsafe conditions, no unsafe behaviours. Can you switch off the CV, and any other technological means of monitoring safety?

It is challenging to create a positive safety culture, where people want to take the safest option, not the quickest option. It is a lot easier to damage that culture. A newly promoted supervisor wants to beat production targets, or a new starter brings ideas from their previous company. Without the right sort of reinforcement, people will revert to shortcuts.

Reducing accidents is not just about people doing the right thing because they know they’re being watched. It’s about a culture where people do the right thing because it’s the most rewarding way to work. Computer vision can help you to identify how to support people to work safely, and will continue to provide the information you need to reinforce and celebrate safe behaviours.

## What about Marks & Spencer?

Did the M&S investment in AI pay off? The safety team identified specific problem areas, and targeted safety conversations in those areas. In one location there was a 40% reduction in unsafe events in just one week. After three months, the number of unsafe events had dropped to just 20% of the initial measurement. There is still room for improvement, as new workers and agency workers learn to work the M&S way. Existing workers see the AI not as a spy on the wall, but as a means of helping the safety team to keep them safe.


# Start building your business case today with the help of our team!

Contact our product experts

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